**Ingenious rocks**

Name

Professor

University/collage

Course code

Date

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**Question 1: Briefly describe the rock cycle; be sure to define each rock type (igneous, sedimentary, and metamorphic) and briefly discuss the processes that lead to the formation of each**

The rock cycle is a fascinating geological process that mirrors the ever-changing nature of our planet's crust. It comprises three distinct rock types, each with its unique formation process: First, Igneous rocks emerge from the mesmerizing dance of molten magma or lava as they cool and solidify. This captivating transformation can unfold deep within the Earth's crust (intrusive) or dazzle us on the surface (extrusive). Remarkable examples of igneous rocks include granite, birthed beneath the Earth's surface, and basalt, which emerges in fiery splendor on the Earth's exterior.

Secondly, Sedimentary rocks narrate a story of gradual accumulation and compaction. They are born as minuscule sediments—sand, clay, or organic matter grains—that gently gather over time. Furthermore, These sediments, often products of erosion and weathering, bond under the gentle pressure of time, forming solid, captivating rocks. The world of sedimentary rocks boasts enchanting limestone, sandstone, and shale specimens.

Lastly, metamorphic rocks are the alchemists of the rock world, shaped by the mysticism of heat, pressure, and chemical interactions. They originate from other rock types, be they igneous, sedimentary, or even other metamorphic rocks. In the crucible of geological forces, they undergo astonishing transformations. The result? A rebirth of rocks with new crystalline structures and mineral compositions. Witness the enchantment of marble, once limestone, and the mystique of schist, born from humble shale.

**Question 2: Igneous rocks are classified based on their TEXTURE and COMPOSITION. Define TEXTURE and COMPOSITION**

Texture in igneous rocks is termed to as to the size, arrangement, and interlocking of mineral grains or crystals inside the rock. It provides insights into the cooling history and conditions under which the rock formed. On the other hand, Composition refers to the mineral makeup and chemical content of the igneous rock. The primary minerals found in igneous rocks are silicate minerals, which contain silicon and oxygen as their major components, along with other elements like aluminum, iron, and magnesium.

**Question 3:** **Define the following igneous rock textures: aphanitic, phaneritic, porphyritic, vesicular, glassy, and pegmatitic**

Here are definitions for the terms

Aphanitic texture describes igneous rocks with fine-grained or small mineral crystals that are very small not to been by naked eye. This texture typically forms when molten rock cools quickly at the Earth's surface or in shallow underground environments.

Phaneritic: Phaneritic texture refers to igneous rocks with coarse-grained or large mineral crystals visible to the naked eye (Kumar et al., 2019). This texture typically forms when molten rock cools slowly deep within the Earth's crust, allowing crystals to grow larger.

Porphyritic: Porphyritic texture describes igneous rocks containing large, visible crystals (phenocrysts) embedded in a fine-grained matrix (groundmass). This texture suggests two stages of cooling: first, slow cooling that forms the larger crystals, followed by faster cooling that includes the smaller groundmass.

Vesicular texture is characterized by small cavities or vesicles within an igneous rock. These cysts result from escaping gas bubbles (usually volcanic gases) from the molten rock as it solidifies. The stone appears to have small holes or voids, often resembling a sponge.

Glassy: Glassy texture describes igneous rocks with no visible mineral crystals that appear as a solid mass of glass. This texture forms when molten rock cools extremely quickly, preventing the formation of crystals. Obsidian is a common example of a glassy-textured rock.

Pegmatitic: Pegmatitic texture refers to igneous rocks with extremely coarse-grained minerals, often with individual crystals that are exceptionally large, sometimes reaching several centimeters or even meters in size. Pegmatites typically form from the slow cooling of water-rich magmas and can contain valuable minerals and gemstones.

**Question 4**: **List the common igneous rock-forming minerals (there are eight or nine) and give their formulas**

* Quartz **-**SiO₂ (Silicon Dioxide)
* Feldspar- Orthoclase: (KAlSi₃O₈) and Plagioclase: (NaAlSi₃O₈ - CaAl₂Si₂O₈)
* Mica **-** Muscovite: KAl₂(AlSi₃O₁₀)(OH)₂ and Biotite: K(Fe²⁺,Mg)₃(Al,Fe³⁺)₂(Si₃AlO₁₀)(OH,F)₂
* Amphibole**-** (Ca,Na)₂-₃(Mg,Fe²⁺,Al)₅(Al,Si₄O₁₁)(OH)₂
* Pyroxene**-** (Ca,Na)(Mg,Fe²⁺,Al,Fe³⁺)₂(Si₂O₆)
* Olivine**:** (Mg, Fe²⁺)₂SiO₄
* Hematite**:** Fe₂O₃
* Magnetite**:** Fe₃O₄

**Question 5: Define ULTRAMAFIC, MAFIC, INTERMEDIATE, and FELSIC**

Ultramafic rocks are igneous with a significantly little silica content, typically less than 45%. They are rich in iron (Fe) and magnesium (Mg) and contain minerals like olivine and pyroxene. Ultramafic rocks are often associated with mantle rocks and are rarely found at the Earth's surface. Examples include peridotite and dunite.

Mafic rocks have a moderate silica content, typically 45% to 52%. High levels of iron, magnesium, and minerals like pyroxene and plagioclase feldspar characterize them. Mafic rocks are darker in color and are common in oceanic crust and volcanic basaltic rocks. Basalt is a well-known mafic rock.

Intermediate rocks, are igneous rocks having a silica content ranging from 52% to 65%. They are medium in Composition between mafic and felsic rocks. These rocks contain minerals like amphibole and both plagioclase and orthoclase feldspar Dóniz-(Páez et al., 2020). Intermediate rocks are often associated with volcanic arcs and can be found in volcanic and plutonic forms.

Felsic rocks, short for "feldspar" and "silica," have a high silica content, typically greater than 65%. They are rich in minerals like quartz, orthoclase feldspar, and muscovite mica. Felsic rocks are generally light in color and include granite and rhyolite. They are commonly associated with continental crust and are often found in continental mountain ranges.

**Question 6: For each of the following igneous rocks, state if it is extrusive or intrusive and whether it is ultramafic, mafic, intermediate, or felsic: Peridotite Basalt Gabbro Andesite Diorite Rhyolite Granite**

* Peridotite:
  + Intrusive
  + Ultramafic
* Basalt:
  + Extrusive
  + Mafic
* Gabbro:
  + Intrusive
  + Mafic
* Andesite:
  + Extrusive
  + Intermediate
* Diorite:
  + Intrusive
  + Intermediate
* Rhyolite:
  + Extrusive
  + Felsic
* Granite:
  + Intrusive
  + Felsic

**Question 7: List and briefly define the three types of volcanoes**

It was concerning their modes of eruption and characteristics, i.e., Shield Volcanoes, Stratovolcanoes, and Cinder Cone Volcanoes. A shield volcano is a type of volcano that possesses a broad and gently spread-out volcanic mountain whose profile resembles the outline of an upturned shield. The usual formations include lava flows characterized as low-viscosity basaltic flow formations. They spread out in many places, forming a gentle slope that seems like a shield structure. The vent of shield volcanoes is usually associated with non-explosive, effusive eruptions. Lava flows slowly out of the vent, and gas content can be moderate. It can travel far because of its relatively less viscous nature. Examples include Mauna Loa in Hawaii.

Secondly, stratovolcanoes comprise alternate layers of lava flows, volcanic ash or tuff, volcanic rock, and breccia. The stones that make up these mountains are usually a mix of basaltic and andesitic to rhyolitic, which give them high elevations (Becerra-Ramírez et al., 2022). This is because the magma within stratovolcanoes is highly viscous, resulting in explosive eruptions. In addition, these eruptions give rise to pyroclastic flows, ash clouds, and volcano bombs, which pose a threat potentially. An example is Mount Fuji in Japan.

Lastly, Cinder Cone Volcanoes are small cone-shaped mountains with steep slopes. Such eruptions tend to be short-lived and explosive, consisting mainly of volcanic material like cinder, ash, or volcanic rock. The explosions are often of a short-lived and volatile nature. The expelled materials fall back down on the surface of the ground and heap around the vent, taking the form of a fan-like structure. Paricutin in Mexico is an example of this type of volcano.

**Reference**

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